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# (54) Improvements relating to hydraulic presses

(57) A hydraulic press comprising a piston-and-cylinder unit controlled by a slide distributor, the slide 16 of which is solidly connected to a screw-threaded rod 18 engaging in a nut 26 fitted in the piston 10 of the piston-and-cylinder unit, the assembly, comprising the screw-threaded rod and the distributor slide being rotatable by a control motor 22. The rod 18 has an axial bore 20 and moves in a cylindrical chamber 28 in the piston 10 said bore communicating with a source 32 of hydraulic pressure when the control motor 22 rotates the screw-threaded rod 18 and the distributor slide 16, so that the piston descends at a speed directly related to the speed of revolution of the control motor 22. When the piston contacts the workpiece, the pressure in the chamber 28 rises and a valve 38 opens so that hydraulic pressure fluid is supplied to a chamber 40 and acts on a larger cross-section of the piston 10.

Fig. 1

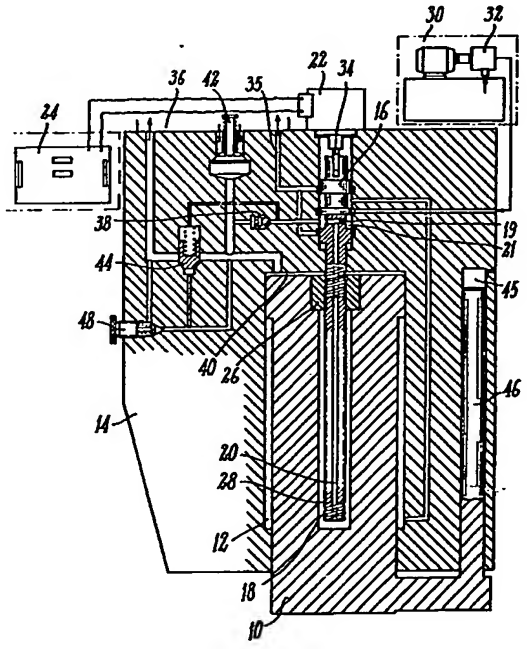


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Fig. 1

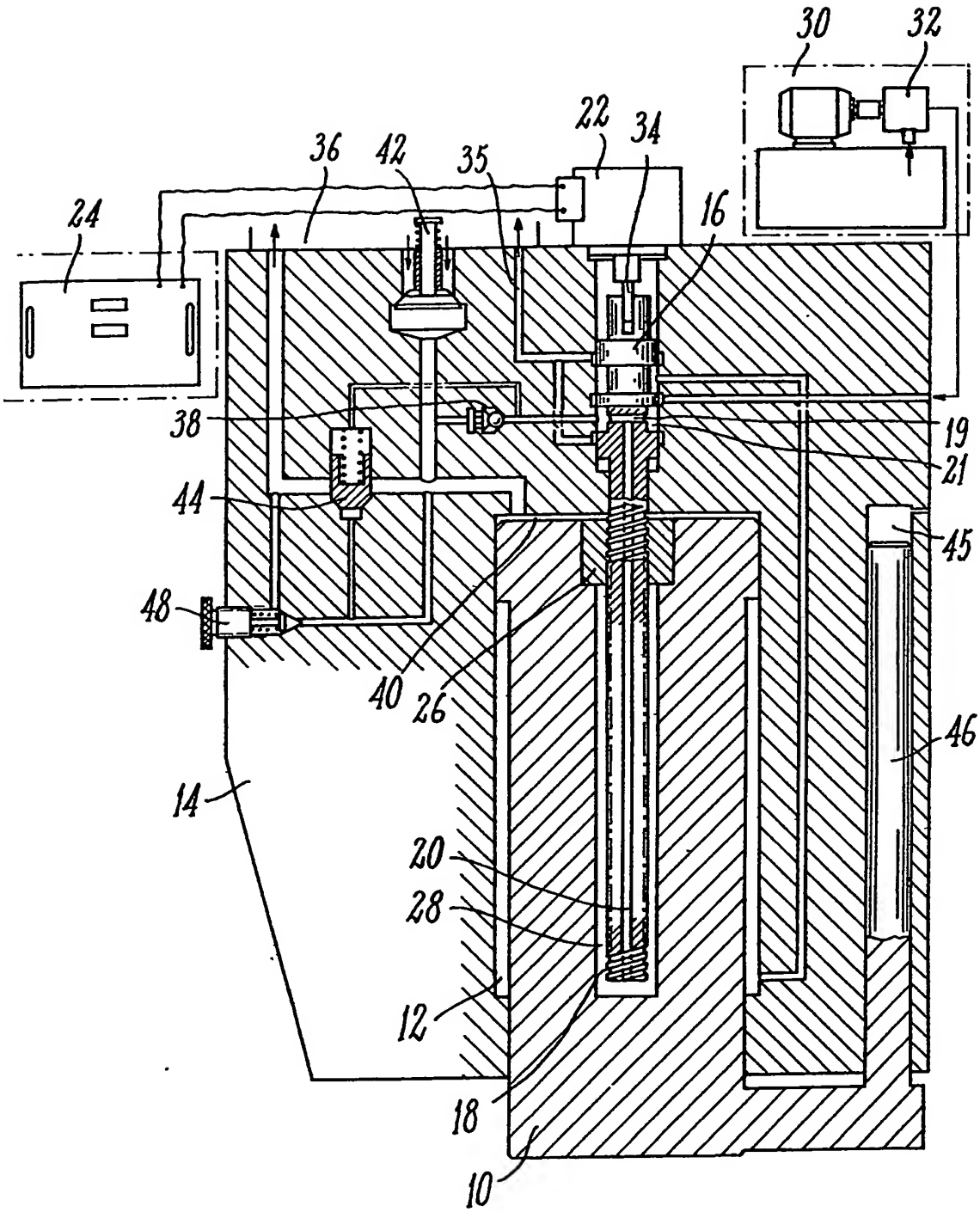


FIG. 2

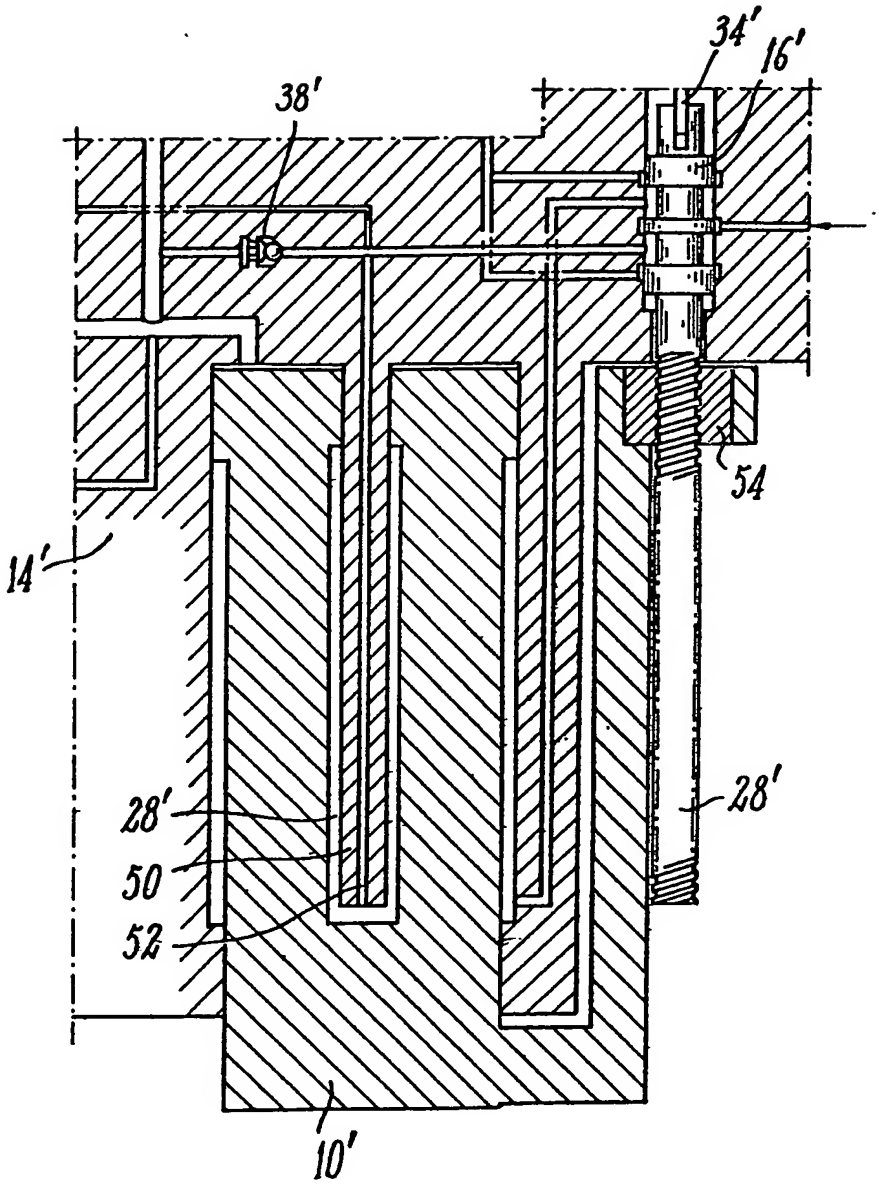
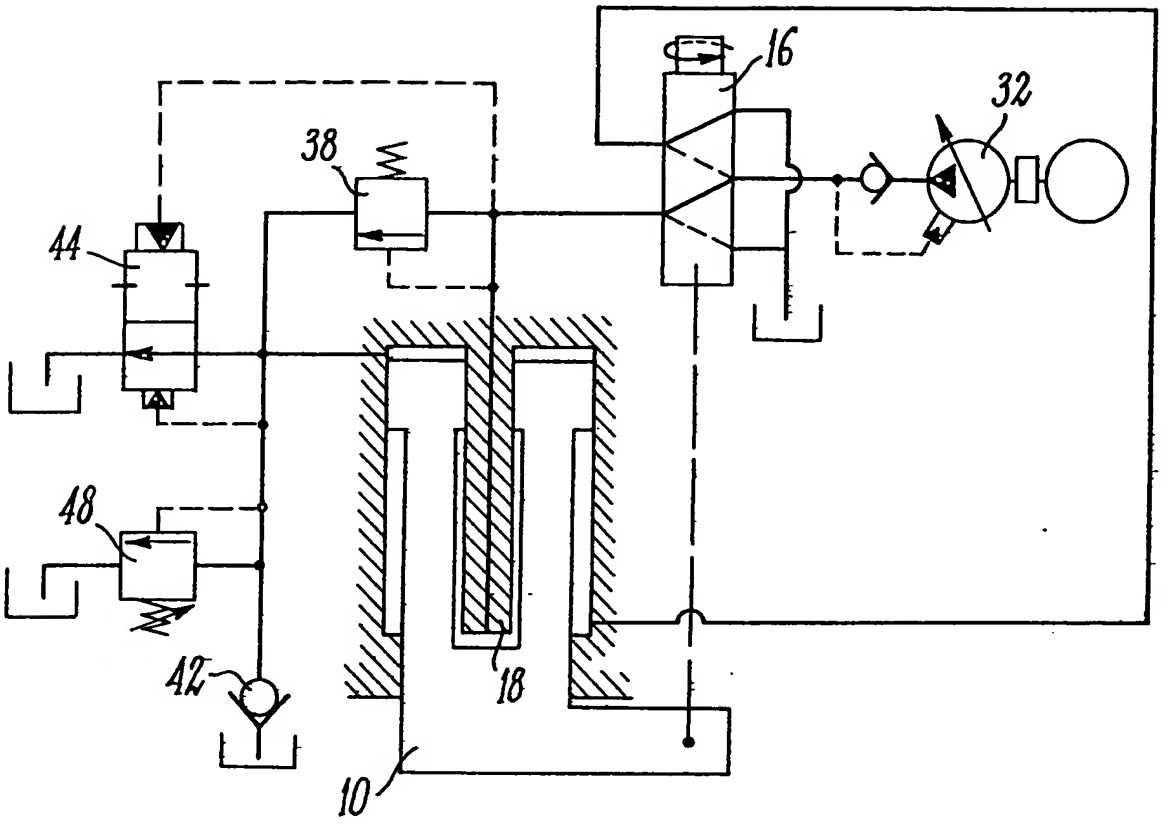


Fig. 3



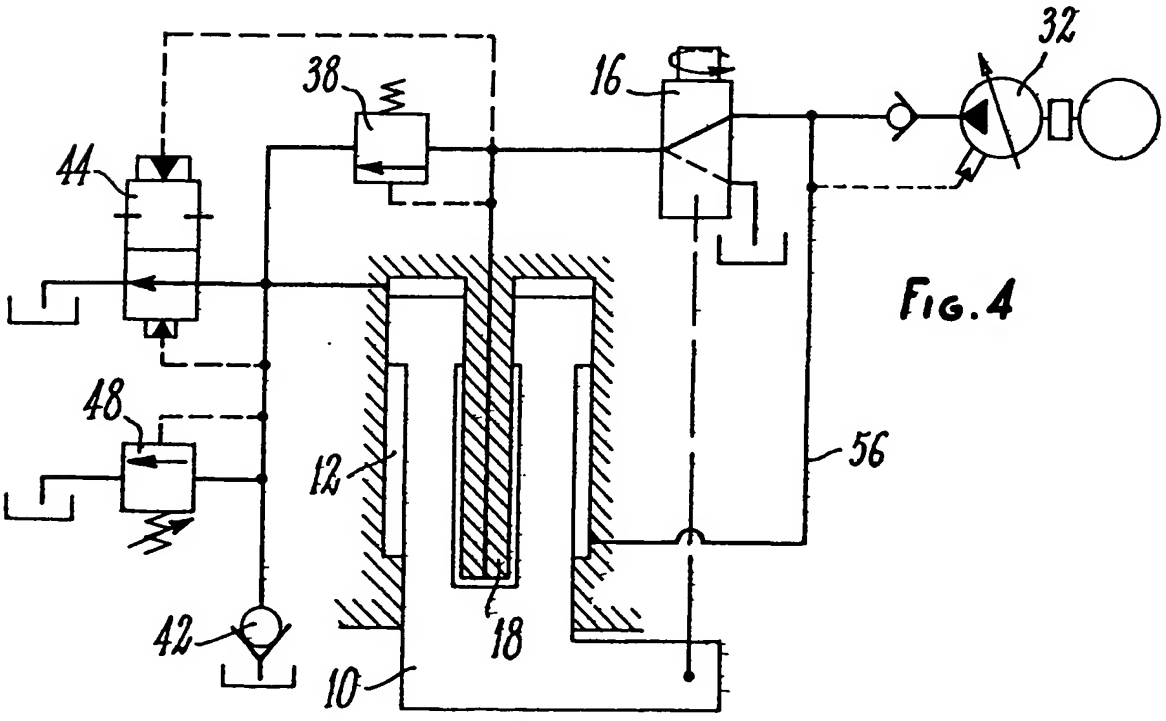




Fig. 4

SPECIFICATION

## Improvements relating to hydraulic presses

The present invention relates to hydraulic presses.

It is known that hydraulic presses must have a certain number of features as regards speeds, positions and forces.

a) *Speeds:* The press must have one or more approach speeds, one or more working speeds, and one or more retraction speeds. Furthermore, the variations in these different speeds must meet a certain number of requirements. In present-day presses, these variations are generally achieved by means of hydraulic units which comprise, in particular, means for regulating or limiting flow, braking flap-valves and electrically operated valves which cut out or operate the various elements.

These conventional means provide results which are very often uncertain and which can be obtained only after a number of adjustments. These adjustments are often different, depending upon variations in temperature, in filtering of the oil, or in the instability or wear of the hydraulic members generally.

With these convention systems it is difficult to obtain, in one cycle, phases having variations in speed or perfectly adjusted and stable speeds, without recourse to complex hydraulic means. Finally, it is possible to obtain only very relative precision by using an adjusting arrangement which is very accurate and therefore expensive. The complex nature of these hydraulic systems is accompanied by the drawback of a lengthy response time as regards the stroke of the press and therefore as regards its productivity, this being due in particular to the inertia of the hydraulic equipment that has to be displaced.

On the other hand, the electro-mechanical control necessary for the correct functioning of this hydraulic apparatus is directly proportional to the complexity of the hydraulic system, and this results in the need to provide large and sensitive electrical equipment housed in cabinets.

b) *Positions:* In contrast to the system in mechanical presses, the piston-and-cylinder unit for applying pressure is positioned against the product to be worked, and this results, in particular, in the following disadvantages: the need for providing different positions of the piston-and-cylinder unit as a function of the same product worked, because of certain variables in the product (in particular, hardness, varying sizes of surface acted upon, etc.), and this is undesirable. Furthermore, since the piston-and-cylinder unit for applying pressure does not always occupy the same position, products that were identical become different and this is also undesirable; the presence of irregularities in the finished product; and premature wear on the press tools for carrying out certain specialised operations.

To offset these difficulties, certain steps can be taken in connection with the conventional presses, in particular: the provision of specific tools for causing the piston-and-cylinder unit of the press to react; construction of a special piston-and-cylinder unit comprising a double screw-threaded rod with an adjustable reaction nut; and the use of mechanical wedging means for causing the piston-and-cylinder unit to react.

When the reactions take place, these various means are accompanied by systematic increases in pressure considerable noise and sudden shocks which can result in deterioration of the piston-and-cylinder unit, of the tools, and of the hydraulic and mechanical elements in general. Finally, the design and provision of such systems, which are always of a specific nature, are not always easy.

c) *Forces:* In the conventional hydraulic presses, one or several pressures is or are regulated during the cycle by way of the hydraulic fluid, this being done by adjusting the pressure of the oil with the aid of conventional means such as, in particular, pressure regulators provided with electrically operated valves which cut out the various regulators in dependence upon the force levels.

In mechanical presses, the above-mentioned means are not provided, since the pressure force is automatically obtained by the reaction of the product to be handled and as a function of its deformation at a predetermined position.

Apart from the problems referred to above, it is necessary to take into account the fact that hydraulic pressures are generally designed to deal with particular operations. In fact, the electrical hydraulic systems have to be arrived at as a function of the phases of the cycle that is to be carried out, these phases being associated with the work that is to be done. It will thus be seen that there are a large number of different types of hydraulic press which are used for different specialised purposes. Particular mention might be made of presses for effecting assembly operations (sleeving, riveting, etc.), for stamping, for straightening, for cutting off, for heading, for compressing, it being impossible, of course, to convert a press of a specific type into one of a different type.

Because of this impossibility of converting hydraulic pressures, there arises the problem of increased floor area for accommodating the presses. In fact, hydraulic presses cannot be converted and it is therefore necessary to invest in other presses when production increases and, in particular, when new products are to be made, so that the existing presses become inactive and non-productive. Finally, under these conditions, it is impossible to programme, from a distance, the parameters of hydraulic presses by means of a centralized programmable automated micro-processor.

According to the invention, there is provided a hydraulic press comprising a piston-and-cylinder unit controlled by a slide distributor, the piston of which is formed with a cylindrical chamber, a screw-threaded rod movably mounted in said chamber and engageable in a nut fitted in the piston said rod being solidly connected to the slide of the slide distributor and having an axial bore formed therein, a control motor operable to rotate the assembly

comprising the screw-threaded rod and the distributor slide, such that the bore in the screw threaded rod is caused to come into communication with a source of hydraulic pressure when the control motor driving the assembly is caused to turn, the arrangement being such that the screw-threaded rod constitutes an approach piston for the piston-and cylinder unit of the press, causing the piston-and-cylinder unit to descend at a rapid approach speed, directly related to the speed of revolution of the control motor.

In an embodiment of this invention, the motor for controlling the piston-and-cylinder unit of the press receives its control signals from an electronic control module, and its power in hydraulic form, by way of a generator assembly, consisting of the screw-threaded rod and the distributor slide, being modulated to obtain all the required cycle phases.

Preferably the hydraulic circuit of the approach piston communicates with that of the piston-and-cylinder unit of the press by way of a pressure-adjusted flap valve which forms a bypass and may be mechanically hydraulically, pneumatically or electrically actuated.

The chamber of the piston-and-cylinder unit is automatically filled by suction through a charging flap valve during the rapid approach phase of the piston-and-cylinder unit, this chamber being voided through a voiding flap valve when the piston-and-cylinder unit of the press rises, this voiding flap valve being used to impart great upward speeds to the piston-and-cylinder unit of the press.

In order that the invention may be better understood, several embodiments thereof will now be described by way of example only and with reference to the accompanying drawings in which:-

*Figure 1* is a vertical sectional view of a first form of construction of a piston-and-cylinder unit for use in the hydraulic press of the invention;

*Figure 2* is a view similar to Figure 1, showing a modified form; and

*Figures 3* and *4* illustrate the hydraulic systems of the two forms in construction of piston-and-cylinder unit illustrated in Figures 1 and 2.

Reference will first be made to Figure 1 which illustrates a preferred embodiment.

This Figure shows the piston-and-cylinder unit of the press, which is displaceable in a bore 12 formed in the body 14 of the unit. The piston-and-cylinder unit is controlled by way of an electronic control module 24 which passes its control signals to it, and is hydraulically powered by means of a generator assembly designated generally by the reference numeral 30 and comprising a motor and a hydraulic pump 32. The piston-and-cylinder unit is controlled by way of a slide distributor 16 which is caused to rotate by a control motor 22 which may be of the fractional or step-by-step type, depending upon the required precision, the rotary drive being achieved by way of a turn-screw type mechanism 34 which permits slide axial displacement of the distributor slide.

The distributor slide is solidly connected to a screw-threaded rod 18 having an axial bore 20 which leads, by way of a radial duct 19, into the chamber 21 of the distributor. The screw-threaded rod 18 engages in a nut 26 solidly connected to the piston 10 of the piston-and-cylinder unit of the press. This rod 18, which is displaceable in an annular chamber 28 formed axially in the piston-and-cylinder unit, constitutes an approach piston as will be described below.

The hydraulic circuit which feeds the annular chamber 28 and the upper chamber 40 of the piston-and-cylinder unit, comprises a bypass 38, a charging flap valve 42, a voiding flap valve 44 and a regulating valve 48. To prevent rotation of the piston 10 of the piston-and-cylinder unit, the latter is solidly connected to a guide piston 46 which is displaceable in a cylindrical chamber 45.

The mode of operation is as follows:

The assembly comprising the screw-threaded rod 18 and the distributor slide 16 is caused to rotate by the motor 22, the direction of rotation of the latter acting on the turn-screw 34, so that the screw-threaded rod is screwed into the nut 26. The assembly consisting of the screw-threaded rod and the distributor slide moves upwardly from the bottom of the piston-and-cylinder unit, and the effect of this is to displace the slide which causes the chamber 28 of the approach piston 18 to communicate with the supply of hydraulic fluid provided by the pump 32, because of the presence of the bores 20 and 21. The annular chamber 12 of the piston-and-cylinder unit 10 is then caused to communicate with a return circuit 35 leading to a tank 36, by way of the distributor. The piston-and-cylinder unit 10 moves out of the body of the press under the action of the pressure of hydraulic fluid in the chamber 28. This pressure is low since no force, apart from that resulting from the output from the piston-and-cylinder unit, is applied to this unit. The bypass 38 thus remains closed, and the piston-and-cylinder unit 10 descends at a speed which is the rapid approach speed directly associated with the speed of revolution of the motor 22. The self-regulating hydraulic pump 32 adjusts itself automatically to the delivery to be provided. The chamber 40 is automatically filled by suction with hydraulic fluid from the tank 36 by way of the charging flap valve 42.

The control module 24 is designed to pass signals to the control motor 22, based, for example, on a certain number of steps of the motor, determining a position of the piston-and-cylinder unit so as to vary as required, the speed of revolution of the motor 22 and thus to obtain unlimited cycle phases. Because of this feature, the low speed or working speed will be obtained by reducing the speed of revolution of the control motor 22.

When the piston-and-cylinder unit 10 comes to bear against the product to be handled, the pressure of the hydraulic fluid rises in the chamber 28 of the approach piston-and-cylinder unit 18, the bypass 38 opens and connects the chamber 28 to the chamber 40. The charging flap valve 42 closes, the upper guide means of the voiding flap 34 acts on the latter so as to close it, and the pressure which then obtains in the chamber 40 and is applied to the large cross-section of the piston 10 corresponds to the normal force of the press.

When the direction of revolution of the control

motor 22 is reversed, the distributor slide 16 is displaced so as to empty the chamber 28 of the approach piston 18. The annular chamber 12 of the piston-and-cylinder unit is then supplied by the hydraulic pump 32. Under the effect of the pressure in the chamber 12, the piston-and-cylinder unit 10 of the press rises. The upper chamber 40 is voided through the voiding flap valve 44 under the effect of the lower guide means of this voiding flap valve, the upper guide means draining by way of the body of the distributor 16.

It will be observed that the voiding flap valve 44 is used for causing the piston-and-cylinder unit of the press to rise at great speed, i.e. for avoiding the need for a distributor 16 of large dimensions as a function of the quantity delivered.

It will be noted that any exterior force tending to displace the rod will automatically cause, in one direction or the other and in the chamber 12 or in the chambers 28 and 40, an instant change in pressure which restores the assembly to equilibrium.

Finally, it will be seen that the arrangement described above ensures additional safety in the operation of hydraulic presses, apart from the normal safety measures called for by the laws relating to industrial undertakings; in fact, the piston-and-cylinder unit 10 of the press cannot suddenly descend accidentally (as the result, for example, of failure of a supply line) in view of the fact that the piston-and-cylinder unit 10 is mechanically connected to the screw 18, the axial clearance of which is only a few millimetres.

The electronic control module 24 for the piston-and-cylinder unit of the press can take the form of an independent element comprising, on the one hand, its own signal-input elements (speeds, positions and forces which will be displayed on an analogue basis by potentiometers or decade counters) and, on the other hand, the elements for supplying the control motor. It might be pointed out that the electronic control module 24 uses a very low electrical power, and that the couples required for the control motor 22 are low, i.e. in the order of a few cm.daN and are relatively constant for controlling the piston-and-cylinder units of hydraulic presses ranging from several hundred daN to several thousand kN.

Finally, it should be pointed out that the hydraulic feed assembly 30 has the sole function of maintaining the feed pressure of the piston and cylinder unit of the press, irrespective of the complexity of the cycles. Consequently, its structure is simple and does not comprise the various distribution means used in conventional hydraulics. Thus, all the problems arising in the various specialist uses of a press are resolved by the press described above and with the aid of a particularly simple hydraulic system.

Figure 3 illustrates the hydraulic system used in the embodiment described above by reference to Figure 1, wherein the slide distributor 16 has five paths. The drawing is self-explanatory, and will not be described in detail.

In the variant illustrated in Figure 4, use is made of a three-path distributor 16. In this case, the annular chamber 12 is connected directly to the hydraulic pump 32 through a line 56.

Figure 2 illustrates a modified form of the invention wherein the assembly consisting of the distributor 16' and the screw-threaded rod 28' is located outside the piston-and-cylinder unit 10' of the press. However, the mode of operation is identical to that of the construction illustrated in Figure 1, the screw-threaded rod engaging in a nut 54 which is solidly connected to the piston of the piston-and-cylinder unit 10' of the press. The approach piston 50, having an axial bore 12, ensures descent of the piston-and-cylinder unit of the press at a rapid approach speed, as in the preceding case.

There has been described an improved hydraulic press which meets the following requirements: that of solving all the problems resulting from different specialisations, thanks to a single simple hydraulic system; that of establishing parameters such as for example, speed, position and force in a very precise manner and so that they do not change with time; that of programming, with the aid of a central computer, all the parameters necessary for the functioning of the press; that of varying the parameters of the press as a function of the products to be handled, with the aid of pick-ups which detect, in particular, the deformation of the work-piece (dimensions) and its weight, and reactions that occur for all forms of the workpiece, etc.; and that of converting the functions of the press in dependence upon the loads.

CLAIMS

1. A hydraulic press comprising a piston-and-cylinder unit controlled by a slide distributor, the piston of which is formed with a cylindrical chamber, a screw-threaded rod movably mounted in said chamber and engageable in a nut fitted in the piston said rod being solidly connected to the slide of the slide distributor and having an axial bore formed therein, a control motor operable to rotate the assembly comprising the screw-threaded rod and the distributor slide, such that the bore in the screw-threaded rod is caused to come into communication with a source of hydraulic pressure when the control motor driving the assembly is caused to turn, the arrangement being such that the screw-threaded rod constitutes an approach piston for the piston-and-cylinder unit of the press, causing the piston-and-cylinder unit to descend at a rapid approach speed, directly related to the speed of revolution of the control motor.

2. A hydraulic press according to claim 1 wherein the control motor for the piston-and-cylinder unit of the press receives its control signals from an electronic control module; and its hydraulic power by way of a generator assembly, the speed of revolution of the control motor being varied so as to provide all the required cycle phase.

3. A hydraulic press according to either one of claims 1 or 2, wherein the electronic module is an independent element comprising, on the one hand, its own input elements for signals such as those relating, in particular, to speeds, positions and forces, and, on the other hand, the supply elements for the control motor.

4. A hydraulic press according to any one of claims 1 to 3 wherein the hydraulic circuit of the screw-threaded rod communicates with that of the piston-and-cylinder unit of the press by way of an adjusted flap valve forming a bypass actuated mechanically, hydraulically, pneumatically or electrically.

5. A hydraulic press according to any one of the preceding claims, wherein the cylinder chamber of the piston-and-cylinder unit is automatically filled, during the rapid approach phase of the piston-and-cylinder unit of the press, by way of a charging flap valve, and is voided by means of a voiding flap valve when the piston-and-cylinder unit of the press rises, this voiding flap valve being used for causing the piston-and-cylinder unit of the press to rise at high speeds.

6. A hydraulic press substantially as hereinbefore described with reference to the accompanying drawings.

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